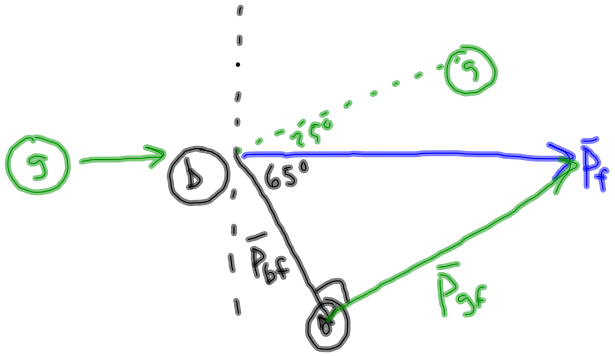
Collision Practice Problems 4th Block 10.11.11

A green ball of mass 10 kg has an initial velocity to the east of 40 m/s. It collides with a stationary black ball that has a mass of 20 kg, and the black ball moves to the south of east at an angle of 65 degrees. The green ball moves to the north of east at an angle of 25 degrees after the collision.
a) What is the final velocity of the green ball?
b) What is the final velocity of the black ball?



$$P_f = P_i = P_{gi} = (10\,kg)(40\,m/s) = 400\,kg\cdot m/s$$

a) $$\sin(65°) = \frac{P_{gf}}{P_f}$$

$$P_{gf} = P_f \sin(65°) = (400\,kg\cdot m/s)\sin(65°)$$

$$= 362.5\,kg\cdot m/s$$

$$P_{gf} = m_g v_{gf} \Rightarrow v_{gf} = \frac{P_{gf}}{m_g} = \frac{363\,kg\cdot m/s}{10\,kg}$$

$$= 36.3\,m/s$$

b) $$\cos(65°) = \frac{P_{bf}}{P_f}$$

$$P_{bf} = P_f \cos(65°)$$

$$= 169\,kg\cdot m/s$$

$$P_{bf} = m_b v_{bf} \Rightarrow v_{bf} = \frac{P_{bf}}{m_b}$$

$$= 8.5\,m/s$$

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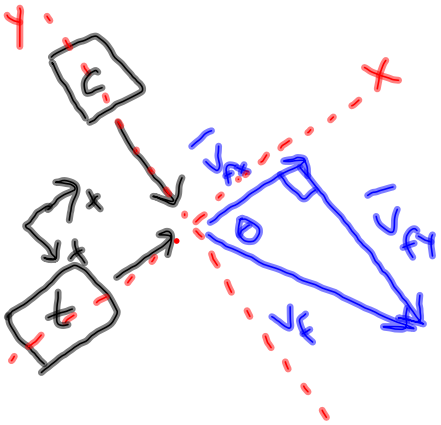
A car with mass 1800 kg is traveling at 35 m/s at 45 degrees south of east and collides with a truck with mass 2500 kg traveling at 20 m/s at 45 degrees north of east. After the collision, the two cars stick together. Find the final velocity of the car and truck as they move together.

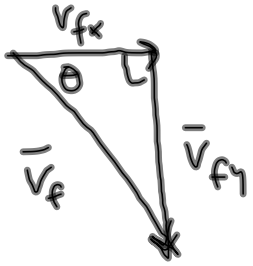


$$m_c\bar{v}_{cix} + m_t\bar{v}_{tix} = (m_c+m_t)\bar{v}_{fx}$$

$$v_{fx} = \frac{m_t v_{tix}}{m_c+m_t} = \frac{(2500\text{ kg})(20\text{ m/s})}{(1800\text{ kg}+2500\text{ kg})} = 11.6\text{ m/s}$$

$$m_c\bar{v}_{ciy} + m_t\bar{v}_{tiy} = (m_c+m_t)\bar{v}_{fy}$$

$$v_{fy} = \frac{m_c v_{ciy}}{m_c+m_t} = \frac{(1800\text{ kg})(35\text{ m/s})}{1800\text{ kg}+2500\text{ kg}} = 14.7\text{ m/s}$$



$\bar{v}_f = 18.7\text{ m/s}$ @ 51.6° S of E

$$\bar{F}\Delta t = m\Delta\bar{v}$$

$$v_f^2 = v_i^2 + 2g\Delta y$$